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Private 5G Network Solution for Small Manufacturing Sites

As the industrial sector looks to 5G, Opticoms* and Nearby Computing's NearbyOne*, powered by Intel®, provide a cloud-based, virtual solution that meets throughput, latency, and security requirements while controlling costs

The adoption of private 5G networks is gaining traction around the world as regulators allocate more spectrum to enterprises to build and maintain their own private 5G networks. The promises of 5G, especially high data rates, ultra-low latency, and high security, have made it attractive to the industrial sector to help accelerate digital transformation.

Many industrial plants have long had their own wired and/or wireless networks to conduct day-to-day manufacturing operations. But numerous emerging technologies in the factory environment that can enhance efficiency and agility, such as collaborative robots and machine learning, require a significant amount of computing and resources that are difficult for these traditional networks to handle. As manufacturers undergo these digital transformation initiatives, they are increasingly building private 5G networks as their preferred connectivity solution.

Even though adoption is not yet ubiquitous, it is evident that forward-thinking industrial sector enterprises are exploring how they can transform their operations with private 5G networks. There were 748 private network deployments in enterprises worldwide in January 2022, an increase of approximately almost 43% since September 2021.[1]

Small businesses were left out of these deployments because of the cost of spectrum and the complexity of building networks. But their access to private 5G is changing due to new technologies, experienced system integration and extensive network integration that simplify the solutions and reduce the cost.

NFV, SDN are Foundational Technologies

The combination of two technologies—network functions virtualization (NFV) and software-defined networking (SDN)—to private 5G networks promise even more benefits. NFV is a key enabler for 5G infrastructure, helping to virtualize all the appliances in the network, including the radio access network (RAN) and the network core.

Together, NFV and SDN enable distributed cloud computing, allowing enterprises to build and maintain their own 5G network in the cloud instead of on the ground. With the cloud, networks can be even more flexible and scalable to meet evolving business needs.

Challenges for Private 5G networks

Despite its promises, private 5G network technology is still unfamiliar and expensive. Costs for edge network deployment, spectrum licenses, and technical support can add up. Solutions can take weeks to months to deploy.

Virtualizing the 5G network consists of running the logical components of the RAN—including centralized units (CUs), distributed units (DUs), and radio units (RUs)—as well as the core—including the Access and Mobility Management Function (AMF), Session Management Function (SMF), and User Plane Function (UPF)—as virtual machines or containers. This requires specific resources on the hardware platform, such as CPUs, RAM, accelerators and hard disk drives, which can lead to high costs for enterprises.

Furthermore, the 5G RAN has a critical requirement for synchronization through the fronthaul network from DUs to RUs. A global navigation satellite system (GNSS) is used as a grandmaster clock to ensure necessary time precision. But this synchronization brings additional costs, especially for small business sites when using the most popular timing configurations (known as O-RAN LLS-C3 or O-RAN LLS-C4).

Moving to the cloud would seem to be a logical alternative but adopting a full cloud solution can negatively impact data throughput, latency, and security requirements.

Opticoms and NearbyOne target small sites

For smaller manufacturing sites requiring three or fewer RUs for full coverage, there is a way to meet data throughput, latency, and security requirements while controlling deployment and maintenance costs resulting from the hardware platform and RAN synchronization constraints. Furthermore, deployment has been reduced to hours or days.

Systems integrator Opticoms has selected Nearby Computing's NearbyOne orchestration platform to offer a cost-effective, end-to-end, cloud-based, and containerized 5G private network solution for small businesses. The solution is illustrated in Figure 1.

NearbyOne offers an all-in-one virtualized platform for deploying, managing, and automating hybrid, heterogeneous, and distributed 5G systems, networks, and applications. NearbyOne addresses all areas of edge deployments: the infrastructure, the network, and the applications, working on top of function-specific components. By creating an internal link between these usually separated areas, NearbyOne can perform sophisticated orchestration functions, uniting each component's capabilities and enabling a higher degree of performance and efficiency. Users can rapidly provision, allocate resources, and fully manage the lifecycle of their edge nodes as a service.

As Intel® Network Builders ecosystem members, the Opticoms and NearbyOne solution is powered by Intel® technology. This includes servers based on Intel® Xeon® Gold 6338N processor, the Intel® Ethernet Network Adapter E810-XXVDA4T, and the Intel® vRAN Accelerator ACC100 Adapter.

Intel® Ethernet 800 Series Network Adapters offer workload-optimized performance and the flexibility to meet high-throughput 5G requirements. Most importantly, the adapters feature very precise packet timing supporting both IEEE* 1588 Precision Timing Protocol (PTP) and Synchronous Ethernet (SyncE) technology to meet the packet delivery needs of IP-based voice services and other real time application traffic in 5G networks. The Intel® Ethernet Network Adapter E810-XXVDA4T has four SFP28 ports supporting 25/10GbE data rates. It also supports an optional GNSS mezzanine card with support for frequency, phase, and time-of-day synchronization.

One of the most compute-intensive 5G workloads is RAN Layer 1 Forward Error Correction (FEC), which resolves data transmission errors that take place over unreliable or noisy communication channels. The Intel® vRAN Accelerator ACC100 Adapter enables balanced platform performance by accelerating Layer 1 FEC algorithms, making more host processing power available for increased channel capacity on edge-based services and applications. This fixed-function PCIe 3.0 adapter works with the Intel® Xeon® Gold 6338N processor to enable a low-cost, power-efficient 5G virtual RAN (vRAN) solution.
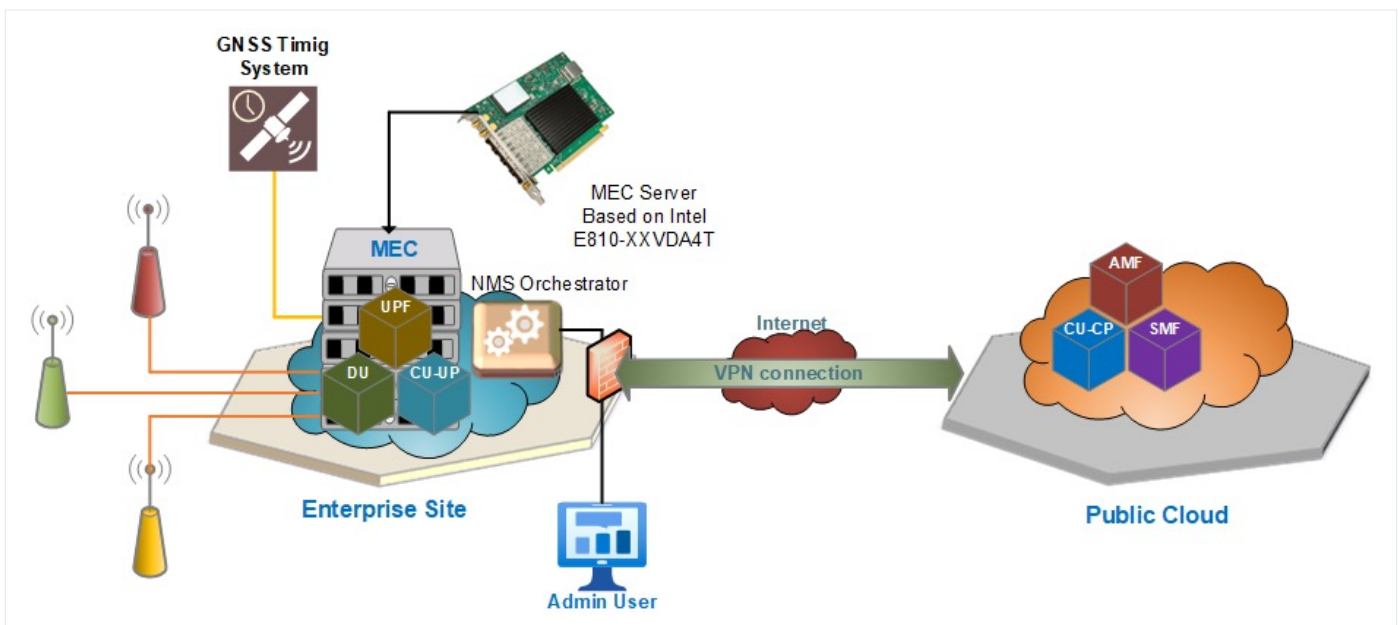

Figure 1. Opticoms-NearbyOne Intel-based solution for small business sites

It's important to note that the solution does not mandate a particular 5G vRAN or core technology. Instead, customers pick their own option. Opticoms and NearbyOne then provide system integration and virtualization.

Opticoms and NearbyOne solution optimized for small business sites

The Opticoms and NearbyOne solution is optimal for small business sites where the number of RUs does not exceed three. With under three RUs, the fronthaul (the connection between DUs and RUs) can be simplified and packet synchronization for voice or real-time applications can be provided by the network adapter. Typically, these features are delivered by the cell site router, but with only three RUs, this router is not necessary resulting in a cost savings on the total solution.

The DU provides the grandmaster clock signal using the Intel® Ethernet Network Adapter E810-XXVDA4T, which supports PTPv2 and SyncE protocols. The network time synchronization is distributed via point-to-point topology between the DU and the RUs (in accordance with the O-RAN LLS-C1 configuration).

In addition to the DU controlling the RUs, the network user-plane functions, central unit control plane (CU-CP) and UPF are hosted at the mobile edge computing server located at the enterprise site. This helps to ensure high data throughputs, low latency, and a high level of security.

Another way to make this solution ideal for small facilities is to host the network control-plane functions CU-CP, AMF, and SMF in the public cloud. As security is a primary concern for public cloud, a VPN connection should be used to exchange control-plane data between both sites.

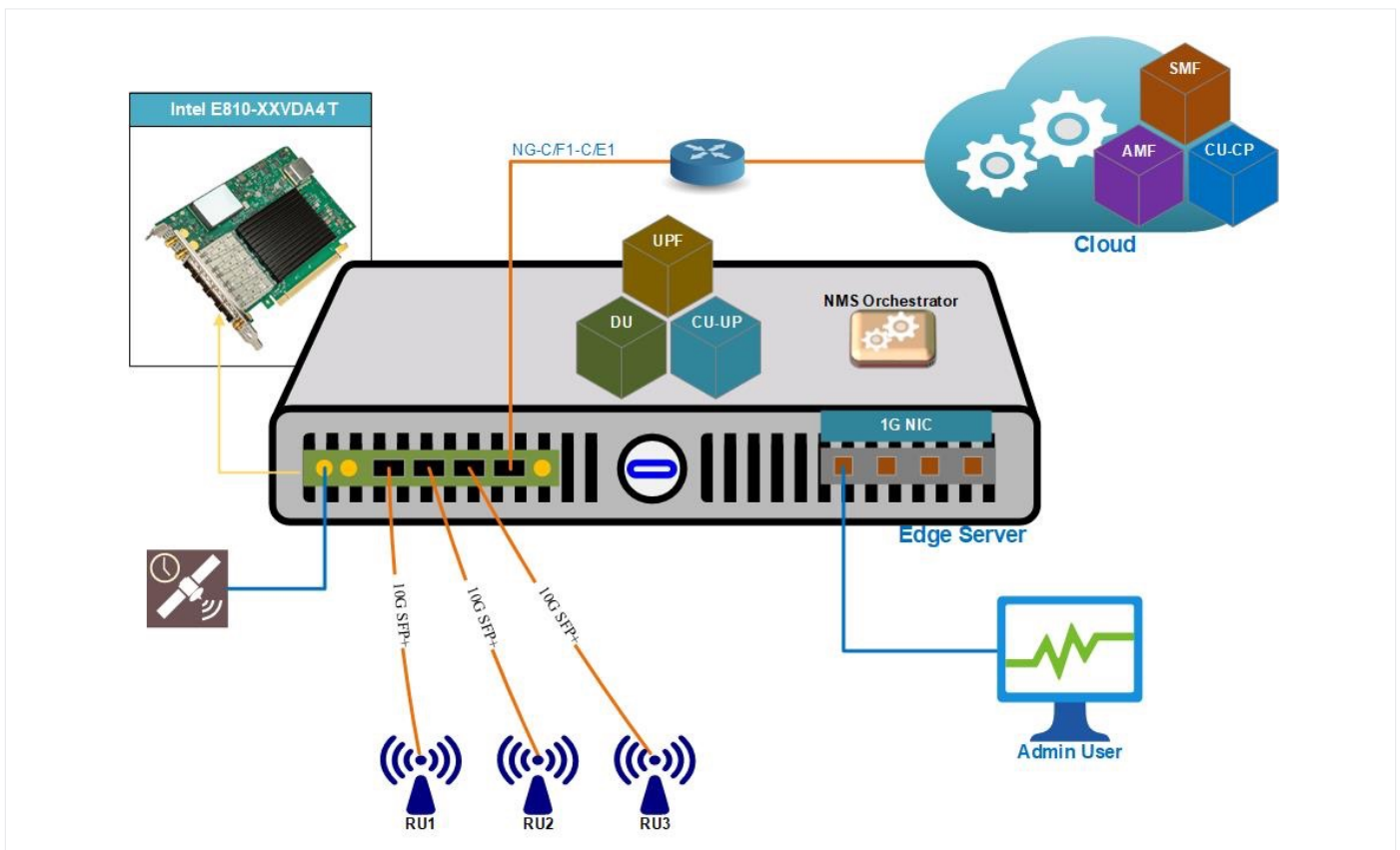Connectivity at the enterprise site is illustrated in Figure 2.

Figure 2. Enterprise Intel® Ethernet Network Adapter E810-XXVDA4T connectivity

Conclusion

Interest in the industrial sector is growing to make manufacturing operations more agile and efficient by implementing private 5G networks. For smaller sites requiring no more than three RUs, there is a viable cloud-based solution that meets data throughput, latency, and security requirements while controlling costs. Systems integrator Opticoms and Nearby Computing's NearbyOne orchestration platform offers a cloud-based and containerized 5G private network solution, powered by the Intel® Xeon Gold 6338N processor, the Intel® Ethernet Network Adapter E810-XXVDA4T, and the Intel® vRAN Accelerator ACC100 Adapter. NearbyOne offers 5G single-pane-of-glass management and orchestration. And the Intel® Ethernet Network Adapter E810-XXVDA4T provides fronthaul and synchronization capabilities that do not require additional equipment, resulting in real cost savings.

Learn more

Opticoms

NearbyOne

Intel® Ethernet Network Adapter E810-XXVDA4T

Intel® vRAN Accelerator ACC100 Adapter

Intel® Xeon® Gold 6338N processor

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